



Thick Film Fact Sheet

Thick Film Technology has been used as an electronic circuit process since 1942 when Harry Diamond Labs developed organic fluid pastes loaded with Silver or Carbon constituents. These pastes could be painted or screened onto ceramics and subsequently fired at high temperatures to burn off the organic carrying agents leaving the basic constituents and glass binders as the circuit. This technology was widely used in armament circuits because of the robustness that the 'solid state' thick film circuit offers.

Today Thick Film technology is used on a wide assortment of products ranging from precision/stable resistors to complex dense electronic assemblies and from high power heating applications to non-electronic seal and adhesive applications. Current TAM estimates the Thick Film market at \$ 650M - \$1B depending on definitions.

Basic Thick Film Advantages:

- The fusion of unlike materials (resistor and conductive transitions) eliminate solder joints or mechanical connections which improve reliability and quality.
- Thick Film sinters into ceramic substrates to form an interlocked bond with the medium. This vastly improves adhesion and peel strength when compared to laminate PCB technology. Recent advancements have produced pastes which adhere to Stainless Steel.
- Thick Film circuits have greater density than traditional circuits. This circuit density is achieved through great Thermal dissipation transfer capabilities of metal products and greater dissipation spreading characteristics of ceramic/isolative materials.
- Flat 2D printing saves space in the vertical dimension. Thick Film circuits are typically 5-25mils high of the base substrate.
- Thick Film technology is an additive process that only uses the material that is deposited. This is an economic advantage especially when depositing expensive precious metals.
- Thick film technology, using paste materials, leads its self to non-traditional yet highly flexible deposition technologies like screening, dispensing and MicroPen patterning.
- Thick film materials have natural high voltage and high current handling ability. Thick film can also handle higher currents, pulse and voltages when applied in thicker or longer traces than traditional thin film or etching technologies.

Thick Film Disadvantages:

- Thick film technology is more difficult to layer than laminate technologies. Typical practical layer capability of thick film is 4-6 layers of conductive traces compared to 10-20 layers available in PWB laminates.
- Thick film sheet resistivity and capacitance is higher than traditional Copper based laminate technologies.
- As layer count increases, thick films tend to be more expensive than laminate technologies.
- Deposition technologies are more difficult to automate than etching, removal technologies.
- Line spacing minimums are typically 3-5mils with screening and 1-3mils with MicroPen deposition technology compared to 0.5-2mils laminate technology and 0.32u semiconductor technology.

Thick Film specifications:

Sheet resistivity:

Pd/Ag composites typically 6-35mOhm/sq

Ag pastes typically 5-6mOhm/sq

Au pastes typically 2-3mOhm/sq

Resistive range (materials)

End members range from 1ohm/sq to 10Mohm/sq for standard materials and down to 10mOhm/sq on specialty

Resistive Range (application)

Traditional 0.1Ohm to 1Gohm

MicroPen 10hm to 3Tohm

Power

Standard 100W/sqin

Special: 385W/sqin and 500W/sqin

Voltage

Typical: 1-10V/linear mils for resistor material

100V/mil Ag Conductive

Cermet based pasted cure at 600-900C (above)

Typical substrate Al₂O₃ Alumina, Quartz, BeO₂, SiN and Stainless Steel (304 & 430)

Polymer Pastes available at lower power and lower voltage (cure at 50-150C)